DOCTOR BLADE SYSTEM, DOCTOR BLADE CLAMPING DEVICE, CHAMBERED DOCTOR BLADE SYSTEM, PRINTING UNIT, METHOD FOR CLAMPING A DOCTOR BLADE, AND METHOD FOR ATTACHING A CLAMPING PORTION OF A CHAMBERED DOCTOR BLADE

TECHNICAL FIELD

The present invention relates to a doctor blade system according to the preamble of claim 1. The present invention further relates to doctor blade clamping device according to the preamble of claim 12. The present invention still further relates to a chambered doctor blade system according to the preamble of claim 22. The present invention also relates to a printing unit according to the preamble of claim 23. The present invention finally relates to a method for clamping a doctor blade according to the preamble of claim 24, and a method for attaching a clamping portion of a chambered doctor blade frame according to the preamble of claim 28.

BACKGROUND

Doctor blades such as chambered doctor blades are extensively used in rotary-printing units, especially flexoprinting units, for applying ink, lacquer, adhesive or the like to a rotatable cylinder included in the printing unit. In a flexoprinting unit for example, the chambered doctor blade serves to ink the screen roller. This occurs by filling the cells or recesses of the roller with ink by means of the chambered doctor blade. Such a chambered doctor blade is disclosed in, for example, WO 93/24328. Chambered doctor blades of this type comprise an elongate frame with two elongate doctor blades, which are arranged alongside the roller in such manner that the longitudinal axis of the chambered doctor blade defines an elongate chamber, which holds, for example, ink. When applying ink or the like to the circumferential surface of the roller, the chambered doctor blade is applied against the same. The function of each doctor blade changes with the direction of rotation of the

roller. One of the doctor blades, the wiping doctor blade, wipes off excess ink while the other merely has a sealing function.

The inking of the screen roller is essential for the printing result. It is of special importance that the screen roller is uniformly inked, which means that the distance between the roller and the doctor blades has to be accurately set. As a result, the chambered doctor blade, usually clamped in the machine frame of the printing unit, has to exhibit good flexural and torsional rigidity.

Prior art chambered doctor blades therefore comprise a sturdy frame, which usually is solid and made in one piece and on which the doctor blades are mounted. EP-A-0 350 839 and WO-A-89/07047, for instance, teach chambered doctor blades of this type.

Conventionally such doctor blade frames are made of solid cast iron or aluminium, or compression-moulded blanks of iron or aluminium provided with stiffening springs to reduce weight. However, these known constructions suffer from some serious drawbacks. First, the chambered doctor blade becomes very heavy and unwieldy and is thus difficult to dismount from the printing unit, e.g. when to be cleaned or replaced. It usually takes two people to dismount a cast-iron chambered doctor blade. Second, one casting mould is needed for each length of chambered doctor blade. Third, the cast-iron structure naturally is liable to corrosion, which constitutes a serious inconvenience, since the printing ink to be circulated in the chamber often contains corrosive components.

The market also provides doctor blade frames consisting of extruded aluminium sections in one piece, but these do not offer any satisfactory solution to the above problems. If to withstand the contemplated strains and to obtain sufficient flexural and torsional rigidity, the aluminium sections have to be comparatively thick and the chambered doctor blade will thus after all become unnecessarily heavy. Further-

more, also the aluminium sections are liable to corrosion, since the printing ink often contains basic substances aggressive on aluminium.

In addition to the requirements discussed in the foregoing, the ink chamber naturally has to be sealed. The doctor blade that removes excess ink for the contemplated direction of rotation of the roller, is the operative doctor blade, and the other doctor blade merely has a sealing function. When the direction of rotation is reversed, it naturally is the other way around. The two doctor blades have to be applied against the circumferential surface of the screen roller in precisely the right way for the ink to be evenly distributed on the roller and to minimise the amount of ink dropping from the lower doctor blade (when being the sealing one). Moreover, special seals are required at each end of the chamber in this respect. Reference is made to US-A-4,581,995, which teaches a sealing unit placed at the end of an ink chamber and consisting of a pressure and labyrinth seal made up of several thin sealing lamellae of polymeric material.

US-A-5,671,673 teaches a chambered doctor blade device where the frame of the cambered doctor blade is, in order to achieve a good stiffening and reinforcing effect, composed of an assembly of interconnected metal sections. The frame composed of metal sections should form a flexurally and torsionally rigid unit which ensures a contact distance between the frame and the cylinder against which the doctor blades are to be applied. With such a design on the frame, the whole chambered doctor blade can be of much higher and more slender construction, without lowering the standards of strength.

The chambered doctor blade device, according to US-A-5,671,673, with an internal chamber having clamping strips, strip-blade holder or single doctor blades, channels and also an external chamber, has too many parts, unnecessary inked surfaces and nooks with capillary slots which are difficult to access in order to achieve simple and effective cleaning in the printing unit.

A general problem with prior art doctor blade systems is that the doctor blades and the cylinder against which the blades are applied are worn out to quickly, which is costly and causes frequent changes of the blades and cylinders, and frequent cleaning operations.

Another problem, which occurs in doctor blade systems is that when the doctor blade clamping portion breaks the whole doctor blade system must be replaced or sent for repair.

OBJECTS OF THE INVENTION

One object of the present invention is to provide a doctor blade system which, despite its low weight, has sufficient flexural and torsional rigidity to ensure that a rotating cylinder is evenly covered, so that the doctor blade has an even contact against the cylinder.

Another object of the present invention is to provide a doctor blade system that is easy to clean and maintain.

A further object of the present invention is to provide a doctor blade system in which the stress on the doctor blade as well as the cells and cell walls of the rotating cylinder decreases.

A still further object of the present invention is to provide a doctor blade system which facilitates simple, safe and fast change of doctor blades and end seals in and outside the printing press.

A still further object of the present invention is to provide a doctor blade system which facilitates simple and quick change of ink without having to remove the chamber from the printing press.

Yet another object of the present invention is to provide a chambered doctor blade system which relatively easy can be renovated.

SUMMARY OF THE INVENTION

These and other objects, apparent from the following description, are achieved by a doctor blade system which is of the type stated by way of introduction and which in addition exhibits the features recited in the characterising clause of the appended claims 1, 12, 22, 23, 24 and 28. Preferred embodiments of the inventive doctor blade system and method are defined in appended subclaims 2-11, 13-21, and 25-27.

An advantage offered by this system is that the doctor blade is being held along its entire long side with a very even clamping force, resulting in, provided that the slit is straight, the blade being held in a straight and plane grip, which in turn leads to the doctor blade having an even contact against the roller.

Another advantage is that, since the doctor blade in its clamping is fully or partly surrounded by at least one elastomer member or the corresponding, the stresses and vibrations from the, in the roller, formed cells affecting the doctor blade will, especially by negative doctoring, be damped, the object of one damping mainly being impacts from the walls/bars between the cells. This decreases the wear of the blade as well as of the cells and cell walls of the roller so that these are worn out more slowly, consequently prolonging the lifetime thereof. This is particularly important for doctor blades in gravure printing, where the surface of the roller generally consists of chromium-plated copper with engraved cells, which are sensitive to wear. In

other applications such as flexo, where a laser engraved cheramic coating provides the surface of a screen roller, the wear decreases mainly on the doctor blade.

A further advantage with the present invention is that by using an elastomer member having a portion formed as a wedge strip the removal and exchange of doctor blades becomes extremly easy and quick. Further, cleaning the doctor blade system is simple and effective as there are substantially no nooks with capillary slots which are difficult to access.

The advantage with lubricating the wedge strip with a suitable lubricant is that the lubricant makes the blade easy to push down against the bottom of the slit, if not already there.

An advantage offered by the simplified embodiment of the clamping of the blade, where the blade only partly is surrounded by an elastomer member, is that the simple application allows an even more simple removing of the doctor blades, and easy access for cleaning, and still having an, although limited, damping, provided by the doctor blade bulging against the elastomer member. The bulging against the elastomer member results at the same time in an additional compensation of the contact of the doctor blade against the mentioned roller.

The advantage offered by using the elastomer members for applying a separate clamping device to the frame is that a firm fixation is achieved at the same time as the possibility of replacing or repairing only the clamping device, if broken, is given. This reduces costs.

DESCRIPTION OF THE DRAWINGS

A better understanding of the present invention will be had upon the reference to the following detailed description when read in conjunction with the accompanying

drawings, wherein like reference characters refer to like parts througout the several views, and in which:

Fig. 1a shows a cross sectional view of a doctor blade clamping device according to a first embodiment of the present invention;

Fig. 1b shows a cross sectional view of a doctor blade clamping device according to fig. 1a, where a portion of the elastomer member has been removed;

Fig. 1c shows a cross sectional view of a doctor blade clamping device according to fig. 1a and part of the roller in motion;

Fig. 2a shows a cross sectional view of a doctor blade clamping device according to a second embodiment of the present invention;

Fig. 2b shows a cross sectional view of a doctor blade clamping device according to fig. 2a, where a portion of the elastomer member has been removed;

Fig. 3a shows a cross sectional view of a doctor blade clamping device according to a third embodiment of the present invention;

Fig. 3b shows a cross sectional view of a doctor blade clamping device according to fig. 3a, where the blade is subject to a flexing force;

Fig. 3c shows a cross sectional view of a doctor blade clamping device according to fig. 3a, where the elastomer member has been removed;

Fig. 4a shows a cross sectional view of a doctor blade clamping device according to a fourth embodiment of the present invention;

Fig. 4b shows a cross sectional view of a doctor blade clamping device according to fig. 4a, where a portion of the wedge strip has been removed;

Fig. 5 shows a cross sectional view of a chambered doctor blade, the clamping portion being resiliently arranged to a supporting portion, the doctor blade being arranged to the clamping portion according to said third embodiment as an example;

Fig. 6 shows a cross sectional view of a chambered doctor blade, the clamping portion being fixed to a supporting portion, the doctor blade being arranged to the clamping portion according to said third embodiment as an example.

DETAILED DESCRIPTION OF THE INVENTION

Fig. 1a shows a doctor blade clamping device 1 according to a first embodiment of the present invention. The clamping device 1 comprises a clamping portion, clamping means in the form of elastomer members 3, 4 which are accommodated in an elongated slit 6 with a certain profile in a solid material holding a doctor blade 5, preferably of band-shaped material, along a long side by means of friction. The doctor blade 5 can be of any suitable material such as steel, polymer or composite material. The elastomer member 3, 4 can for example be EPDM with a hardness of about 70 degree Shore.

A portion of the elastomer member 3, mounted in the slit 6, is shaped as a wedge strip 3, which can be easily removed by gradually being pulled out of its position by hand. This is preferably achieved by bending on the upper edge of the elastomer member 3. When the wedge strip 3 is stretched, its cross-sectional area decreases so that it easily crawls out of the slit 6. Thereby the clamp/friction joining is opened so that the doctor blade 5 easily can be removed and replaced by a new blade. Fig. 1b shows the doctor blade clamping device 1 according to fig. 1a, where a portion of the elastomer member 3 has been removed.

The remaining part 4 of the elastomer member, accommodated in the slit 6, may remain or be removed for cleaning.

When a new doctor blade 5 has been accommodated in the slit 6 (see fig. 1b) the wedge strip 3, 4 is lubricated with a suitable lubricant and is then mounted thereon by manually pressing the strip, bent on its upper edge, gradually from one end of the doctor blade to the other end.

Subsequently it is checked that the doctor blade 5 actually rests against the supporting part of the elastomer member 4, or according to alternative embodiments against a member 4b, or against the bottom 7 of the slit 6, by manually guiding a rag by pressing it towards the slit 6 bottom 7 along the freely projected long side of the blade. The lubricate makes the blade 5 sliding down against the bottom 7 of the slit 6, if not already there. After some time the lubricant is repressed by the forces acting in the slit 6, so that the friction between doctor blade 5 and wedge strip 3 substantially increases and provides an adequate fixation of the blade 5.

Fig. 2a shows a doctor blade clamping device 1 according to a second embodiment of the present invention. It is a simplified solution of the clamping of the blade 5, where the blade 5 only partly is surrounded by an elastomer member 3, i.e. at the side against which the blade bulges and the bottom 7 of the slit 6. Thus, according to the second embodiment the clamping means comprises the elastomer member 3 and, preferably, an elastomer bottom support 4b.

Fig. 3a, 3b and 3c show a doctor blade clamping device 1 according to a third embodiment of the present invention. It is a further simplified application of the clamping of the blade 5, where the blade 5 only partly is surrounded by an elastomer member 3. In this case, only a limited damping is obtained, caused by the blade bulging somewhat against the elastomer member 3 when the blade 5 is subjected to

a bending force from the wedge strip/elastomer member 3 side. Fig. 3b. Inward bend in the elastomer member 3 results at the same time in an additional compensation of the contact of the doctor blade 5 against the mentioned roller 20.

In a further embodiment an elastomer member 3, 4 could be shaped in one piece having a cut where a portion of the doctor blade 5 is introduced.

Fig. 4a and 4b show a doctor blade clamping device 1 according to a fourth embodiment of the present invention, where the clamping portion 2 is provided with a deep slit 6 for accommodating a doctor blade 5 by means of a "hard" wedge strip 3, 4.

In contrast to a clamping portion 2 provided with a shallow slit 6 for the doctor blade 5, e.g. 5-8 mm, or alternatively approximately 30 % of the width of the blade, the width of the blade being in this case 22-25 mm, where the blade is held by a "soft" resilient wedge strip 3, 4, as described in the preceding embodiments, a clamping portion 2 provided with a deeper slit 6, e.g. an additional 30-50 % of the width of the blade, may use at least one substantially harder wedge strip 3' of e.g. PVC material, where the shank/shanks 2', 2"of the clamping portion 2 are resiliently arranged and contribute to the resilient and clamping action of the clamping portion 2. This resilience allows the hard wedge strip 3' to be mounted, by pressing it into the slit passing a locking therein. When the shanks of the slit 6 are pre-stressed by means of the wedge strip 3' a clamping force is realised, holding the doctor blade in place by means of friction.

The slit 6 in the clamping portion 2 may be shaped in such a way that the upper part resembles the shallower slit 6 with a "soft" wedge strip 6. Additionally the slit 6 may have a step for supporting the doctor blade or a recess for a "bar" of resilient material for supporting the blade, or alternatively only the foot of an L-profile. The slit 6 may then proceed further into the clamping portion 2 having the shape of a

thin slit 6 terminating in a beading 7 for improved fatigue strength. This part of the slit may advantageously be filled with a foamed strip 4' of elastomer member material for damping action and to prevent ink from penetrating into the clamping portion 2 making cleaning thereof more difficult.

Thus, according to the fourth embodiment, the clamping means comprises the resilient shank/shanks 2', 2" and , when applicable, the resilient bottom support 4'.

The wedge strip/elastomer member 3, 4, 4b is intended for the use of doctor blades having a thickness ranging between 0.06 and 2 mm, preferably between 0.10-0.20 mm, i.e. thin, flexible materials.

The new blade clamping method also gives totally new possibilities for forming a chambered doctor blade. Fig. 5 shows a chambered doctor blade system 9 of stainless sheet with two clamping portions 2 in the form of two profile mouldings 2 in extruded aluminium mounted over the end portions 10', i.e. the shanks 10' of the supporting portion 10 of the frame of the chambered doctor blade system, in the form of a substantially U-shaped sheet profile 10.

The profile moulding 2 of aluminium is attached with an own wedge strip/elastomer member 11 against the sheet shank 10', the profile moulding having a slit 12 into which the shank is introduced and clamped. This wedge strip 11 offers a more powerful clamping, since the aluminium profile moulding 2 can be considered fixed on the shanks 10' of the U-shaped sheet profile 10.

Clamping portions 2, e.g. a profile moulding 2 of aluminium, shall only with difficulty be dismounted and replaced if it has been damaged. The joining may be supplemented with a capillary acting glue/adhesive between profile moulding/sheet in order to make it totally slot free, where printing ink otherwise could penetrate and cause cleaning problems.

The doctor blade is as described earlier mounted with an own wedge strip/elastomer member 3, 4 arrangement.

Fig. 6 shows a second embodiment of a chambered doctor blade where another type of clamping portion 2 is screwed on to a stainless sheet profile with brims. This solution is suitable for bigger and longer chambers where the stainless sheet profile has to be made more rigid. The aluminium profiles can also in this embodiment be exchanged if they have been damaged.

The doctor blade is as earlier mounted with an own wedge strip/elastomer member 3, 4 arrangement.

The clamping portion 2, and the sheet profile 4 may of course be of any suitable material, and may be formed together in one piece.

The method as well as the function of the system and other arrangements according to the invention should to a substantial part have been made clear from the description given above.

Thus, according to the basic idea doctor blades are held in a clamping portion by means of at least one resilient clamping means providing a damping action for the blade and making the mounting and dismounting extremely simple. The blade is inserted in a slit whereafter the resilient clamping means, preferably prepared by a lubricant, are introduced, bit by bit from one end of the slit to the other, the introduction being substantially perpendicular to the longitudinal direction of the slit. Dismounting is performed in the reverse way.

Further the invention offers an extremely well-defined application of a doctor blade which is important and provides an even contact between roller and blade.

An even contact between the doctor blade and the wiped off roller is absolutely necessary in order to be able to use a low contact pressure between the doctor blade and the roller, which in turn is a necessary condition for providing a long life for the doctor blade as well as the roller surface.